

THE REGISTERED APPRENTICESHIP OCCUPATIONS AND STANDARDS CENTER OF EXCELLENCE (AOSC)

Junior Cloud Engineer National Occupational Framework

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(added recommended number of hours for apprenticeships on page 2)

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Introduction to Using This Document

Under the Registered Apprenticeship Technical Assistance Centers of Excellence award, the Urban Institute leads the Occupations and Standards work. One of the main objectives of Urban's project is to create high-quality, well-researched, consensus-based work process schedules that are nonproprietary and widely available. This document is a product of that work and contains three sections: the occupational overview, the work process schedule, and the related technical instruction.

The **occupational overview** is a general introduction, including alternative job titles, any prerequisites, and, if applicable, the total number of hours needed to complete a time-based or hybrid program.

The **work process schedule** outlines the major job functions, competencies, and/or hours an apprentice completes in a registered apprenticeship program. It outlines what apprentices are expected to learn on the job with the support of a mentor or journeyworker (a worker mastering the competencies of an occupation in a particular industry), including both core competencies and those deemed optional by experts in the field. The work process schedule is the foundational document guiding a program.

Urban works with numerous experts to ensure the content is thoroughly researched and vetted to reflect the expectations of industry, educators, unions, and other apprenticeship stakeholders for this occupation. Sponsors and employers can use the work process schedule as their program standards with assurances it has been approved by experts in the field.

The **related technical instruction** presents considerations for the coursework that apprentices will undertake to supplement on-the-job learning. It is intended to serve as a reference to sponsors exploring their options for the accompanying classroom, virtual, or hybrid training.

How to Use the Work Process Schedule

Sponsors can adapt the work process schedule to accommodate their needs for competency- or time-based or hybrid programs. In a **competency-based** apprenticeship, sponsors assess apprentices' progress across core and optional competencies listed in the work process schedule. In a **time-based** apprenticeship, apprentices complete a predetermined number of hours across major job functions and the program overall. In a **hybrid** apprenticeship, sponsors monitor apprentices' hours spent on major job functions and assess their proficiency across competencies.

Each program type has a different method of assessment:

- **For a competency-based program**, apprentices engage in activities and make progress toward proficiency in the identified competencies. Sponsors overseeing apprentices' work assess their mastery of the outlined competencies using the following rating scale:
 - 4—Competent/proficient (able to perform all elements of the task successfully and independently)
 - 3—Satisfactory performance (able to perform elements of the task with minimal assistance)
 - 2—Completed the task with significant assistance
 - 1—Unsuccessfully attempted the task
 - 0—No exposure (note the reason—absence, skill isn't covered, etc.)

The competencies may be completed in any order. Apprentices must perform at a level 4 or 3 in all competencies listed as “core” to complete the apprenticeship program successfully.

- **For a time-based program**, sponsors monitor apprentices' completion of hours in training across major job functions. The total number of hours recommended for this occupation is listed in the occupational overview and is based on guidance from the US Department of Labor. Generally, apprentices must have at least 2,000 hours overall for on-the-job learning, but occupations of greater complexity may require more hours. Sponsors will provide apprentices with supervised work experience and allocate the total number of hours across the major job functions to adequately train their apprentices.
- **The hybrid approach** blends both competency- and time-based strategies. Sponsors measure apprentices' skills acquisition through a combination of completing the minimum number of hours of on-the-job learning and successfully demonstrating identified competencies. Sponsors will assess apprentices' proficiencies as described for competency-based programs with a rating scale of 0–4 for every core competency. Generally, apprentices have at least 2,000 hours overall for on-the-job learning, but occupations of greater complexity may require more hours. Sponsors will document apprentices' completion within a minimum and a maximum range of hours assigned for each major job function.

Junior Cloud Engineer Occupational Overview

Occupational Purpose and Context

Junior cloud engineers support cloud engineers in building, servicing, and maintaining cloud-based services and applications for a company. Additionally, they support businesses' migration to cloud-based solutions that align with a company's infrastructure. Junior cloud engineers can choose to specialize in a more specific role, such as cloud architecting (designing components for a company's cloud architecture and position in cloud environments). They often implement and configure cloud-based infrastructure and software, maintain cloud-based services, create operating procedures, identify and correct problems, or create production and migration schedules. They provide support to the end user using various cloud platforms and provide solutions for end users having technical difficulties. Junior cloud engineers may also manage virtualized data centers, including servers, storage, backup and recovery, and networking.

Potential Job Titles

Cloud support engineer, cloud developer, junior site reliability engineer, cloud technician, cloud computing technician, cloud systems administrator, cloud specialist, cloud computing specialist, cloud customer service, cloud data center manager

Apprenticeship Prerequisites

To become a junior cloud engineer apprentice, candidates should have existing computer programming and development skills. Some companies may require basic knowledge in specific programming languages like .NET, Java, Python, or Ruby. Additionally, candidates should have strong communication skills and be comfortable working in teams. Most candidates will benefit from having experience resolving end-user issues, and all candidates should have an interest in developing and strengthening customer service skills throughout the apprenticeship.

Entry-level (junior) cloud engineers would benefit from having exposure to cloud environments such as Amazon Web Services (AWS), Microsoft Azure, Google Cloud Platform, or Salesforce. They should be prepared to develop specialized knowledge of a select cloud provider, such as AWS, Azure, or Google, depending on the cloud platform used at the workplace. In general, a qualified junior cloud engineer will have prior experience in technical support, IT, and cloud computing principles.

Recommended Length of Apprenticeship (Time-Based/Hybrid Programs Only)

The recommended length of time for on-the-job training in a junior cloud engineer apprenticeship is 2,000 to 4,000 hours.

Work Process Schedule

Junior Cloud Engineer

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Program approach type (time-based, competency-based, hybrid):

Instructions for Use:

Competency-based programs: In the “performance level achieved” column of the work process schedule (see examples starting on the next page), assess apprentices’ performances on each competency using the scale below. No monitoring of hours is required for this approach. However, competency-based apprenticeship programs must last at least 12 months (see “Guidelines for Competency-Based, Hybrid and Time-Based Apprenticeship Training Approaches,” US Department of Labor, Employment and Training Administration, Office of Apprenticeship, October 20, 2015,

<https://www.apprenticeship.gov/sites/default/files/bulletins/Cir2016-01.pdf>).

- 4—Competent/proficient (able to perform all elements of the task successfully and independently)
- 3—Satisfactory performance (able to perform elements of the task with minimal assistance)
- 2—Completed the task with significant assistance
- 1—Unsuccessfully attempted the task
- 0—No exposure (note the reason—absence, skill isn’t covered, etc.)

Time-based programs: In the “hours” row, specify the number of hours apprentices will fulfill for each job function. No assessment of competencies is required for this approach.

Hybrid programs: In the “performance level achieved” column, assess apprentices’ performances on each competency using the 0–4 scale above. In the “hours” row, identify a range of hours apprentices should spend working on each major job function.

Job Function 1: Effectively communicates, plans, and engages internally and with clients		
Hours (time-based and hybrid programs only):		
Competencies	Core or optional	Performance level achieved (0–4) (competency-based and hybrid programs only)
A. Fosters open communication through active listening and facilitates shared understanding across teams and clients	Core	
B. Collaborates and builds relationships with teams and clients, offers and accepts feedback respectfully, meets others with empathy, and seeks additional feedback and perspectives	Core	
C. Participates in self-planning activities, such as managing workflow and prioritizing tasks and applying Agile principles (or similar)	Core	
D. Estimates and reports timelines and outcomes, sets goals, focuses on solutions, and coordinates requests with other service units	Core	
E. Proactively anticipates issues before they arise and maintains a sense of ownership in all projects	Core	
F. Addresses challenges with curiosity, seeks to understand the root cause, and initiates follow-up conversations to provide insight and resolutions in a positive manner	Core	
G. Coordinates with engineering team on complex issues requiring escalation and effectively coordinates with teams in different time zones	Core	

Job Function 2: Explores, identifies, and presents to clients cloud and network services offerings		
Hours (time-based and hybrid programs only):		
Competencies	Core or optional	Performance level achieved (0–4) (competency-based and hybrid programs only)
A. Demonstrates familiarity across relevant cloud and network services offerings and infrastructure, including operating systems, cloud services, databases, applications, platforms, software solutions, artificial intelligence (AI) tools, machine learning, virtualization, automation, security, storage solutions, and network services solutions	Core	

B. Continuously improves familiarity with and ability to write code for web and programming languages	Core	
C. Supports those leading the discovery phase, applying user-centric practices	Core	
D. Demonstrates an understanding of client needs and existing client infrastructure	Core	
E. Combines research and client feedback to identify appropriate offerings	Core	
F. Distills technical concepts and presents a solution clearly to teams and clients and provides accurate information on available offerings	Core	
G. Presents ideas clearly, seeks feedback, and turns feedback into actionable improvements with a team	Core	
H. Maintains clear and updated documentation of user needs and changes	Core	
I. Familiarizes oneself with relevant cloud offerings, has interest in continuous learning, and seeks new knowledge of evolving cloud services	Core	

Job Function 3: Contributes to planning and configuring cloud and network services offerings		
Hours (time-based and hybrid programs only):		
Competencies	Core or optional	Performance level achieved (0–4) (competency-based and hybrid programs only)
A. Carries out plans for configuring and maintaining and troubleshooting issues for cloud and network services offerings	Core	
B. Adheres to the rollout approach, transition plan, and schedule for migrating nonsensitive data for new customers	Core	
C. Assists with detailing how the delivery and maintenance of cloud services will be staffed and reported	Core	
D. Assists with creating and configuring cloud data storage and accounts in cloud services	Core	
E. Supports and configures data backup systems and services	Core	
F. Accesses and transfers nonsensitive data between systems and services with a team, following company standards for security, compliance, and procedures	Core	

G. Applies Agile principles (or similar), such as small-batch practices, iterative development, course correction, and retrospectives, for continued improvements	Core	
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Job Function 4: Supports implementation and deployment of cloud and network services offerings

Hours (time-based and hybrid programs only):

Competencies	Core or optional	Performance level achieved (0–4) (competency-based and hybrid programs only)
A. Contributes to designing solutions and writes code to facilitate and manage the configuration, automation, updates, and overall health of cloud and network services offerings	Core	
B. Supports defining and building disaster-recovery testing procedures with a team	Optional	
C. Writes code for automation	Core	
D. Conducts diagnostics, troubleshooting, and testing	Core	
E. Supports guiding clients through provisioning and configuring cloud and network services offerings	Core	
F. Understands concepts of continuous integration and continuous deployment	Core	
G. Adheres to change-request processes to meet auditability and compliance requirements	Core	

Job Function 5: Supports management and maintenance of cloud and network services offerings

Hours (time-based and hybrid programs only):

Competencies	Core or optional	Performance level achieved (0–4) (competency-based and hybrid programs only)
A. Monitors cloud assets using automated and manual tools, identifies emerging defects and troubling patterns, anticipates and prevents customer impacts	Core	
B. Follows deployment schedule of batches to address vulnerabilities	Core	

C. Implements and monitors data and network security (e.g., vulnerability scanning, intrusion detection, and Product Security Incident Response Team [PSIRT] remediation)	Core	
D. Identifies and administers the appropriate technologies for achieving data backup control	Core	
E. Troubleshoots availability and performance issues	Core	
F. Accesses and transfers nonsensitive data between systems and services	Core	
G. Writes scripts to facilitate configuration of and updates to cloud accounts	Core	
H. Uses automation for common tasks, corrects failures, and follows up on failure alerts	Core	

Job Function 6: Provides ongoing troubleshooting support and maintains documentation		
Hours (time-based and hybrid programs only):		
Competencies	Core or optional	Performance level achieved (0-4) (competency-based and hybrid programs only)
A. Continuously adheres to change-request processes to meet auditability and compliance requirements	Core	
B. Gathers information to identify and scope issues with urgency and ownership	Core	
C. Determines appropriate resolution tier (resolve or escalate) and escalates with urgency and ownership	Core	
D. Applies troubleshooting practices	Core	
E. Tests and implements fixes and documents changes	Core	
F. Effectively uses task-assignment and record-keeping systems	Core	
G. Documents final resolution information and status within record-keeping systems and relevant documentation	Core	
H. Tracks ongoing issues and patterns to identify common issues and develop solutions	Core	

Related Technical Instruction

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Instructions for Use:

Registered apprenticeships must include at least 144 hours of related technical instruction (RTI). Courses offered by accredited colleges and universities may be assigned a credit hour determination rather than a contact hour determination. In general, an academic credit unit is the equivalent of 15 clock hours of instruction.

Development and use of this RTI outline: Employers and academic institutions may approach RTI in markedly different ways. Our goal was not to identify the single best way to provide RTI or to identify a single provider whose content we deemed to be superior. Three cloud services providers host the majority (63 percent) of cloud-based services globally (see “Global Cloud Services Spend Up 33% to Hit US\$62.3 Billion in Q2 2022,” Canals, August 1, 2022, <https://www.canalys.com/newsroom/global-cloud-services-Q2-2022>). Thus, we have identified training across those specific cloud environments. This is not an exhaustive list of cloud environments an apprentice could need to learn, as it depends on the cloud environment a company uses. An apprentice would need to be skilled in at least one cloud environment, which is defined by the company. Additionally, our goal was to survey numerous education providers, including employers, institutions of higher education, high schools, private continuing education providers, labor organizations, professional associations, and, in some cases, municipalities that provide worker training, to identify topics or courses common among those providers that align with the job functions included in this work process schedule. Those common topics or courses are reflected in the RTI outline provided below, which may be useful in developing your RTI program or communicating your needs to an educational partner.

Licensure or certification requirements: State occupational licensure is not required for this career; however, employers often require junior cloud engineers to be vendor certified for the systems or programs the business uses.

Degree requirements for licensure or certification, if applicable: N/A

Accreditation requirements of instructional provider for licensure or certification, if applicable: N/A

Anticipated changes in licensure or certification requirements, if known: N/A

Examples of state licensure or certification requirements: N/A

Examples of RTI providers for this occupation

Colleges and universities: Colleges and universities typically offer courses on various computer programs or platforms through their noncredit and continuing education programs. In some instances, completing such a course is required to be eligible to take a vendor proficiency exam. Cloud services and network management courses may be available through college and university computer science programs or departments.

No-cost online providers: Coursera and edX offer numerous free courses on various aspects of business management, computer software and services, programming languages, and systems management. Coursera generally hosts courses provided by US colleges and universities, whereas edX hosts courses provided by colleges and universities around the world. Although these platforms provide no-cost instruction, students who wish to participate in projects, have their work reviewed, or earn credit for completing a course are generally required to pay a fee.

Continuing education or specialty education providers: In the IT field, many vendors offer education and training programs, as well as certification programs, for users competent in particular software, systems, or services. In addition, several continuing education providers advertise short training programs (30 hours) for preparing junior cloud engineers, but many of these short courses require students to have considerable experience in the field and a basic understanding of cloud computing before enrolling.

Prerequisite knowledge, skills, or experience typically required by RTI providers for this occupation

Individuals who enter this apprenticeship are generally expected to have basic knowledge of computer hardware and standard business programs or services (such as Microsoft Office and Google Docs) and experience using email and messaging services to communicate with others. Some employers may want apprentices to have some basic coding experience in one or more commonly used programming languages, such as C++, Java, Python, or Ruby. Some companies may require apprentices to have or obtain a security clearance. Some employers may also seek employees who have prior experience in customer service, such as through a job as a computer help desk technician.

Effective business communication

Hours: 15

Sample learning objectives

- Demonstrate the ability to format a business letter, a memo, and a meeting summary using Microsoft Word.
- Explain the importance of communication with peers, supervisors, and clients and explain how communication to each of these groups might differ.
- Demonstrate the ability to write an email, a proposal, and a business letter using proper punctuation, grammar, capitalization, and sentence structure.
- Describe the resources that can be helpful in writing or proofreading written communication.
- Demonstrate active listening skills.
- Demonstrate the ability to give instructions clearly, completely, and in the correct order.
- Demonstrate the ability to speak clearly to a group and to articulate the key points of your message to the listener.

Introduction to business management

Hours: 10–15

Sample learning objectives

- Describe what a business is and what the primary functions of a business are.
- Explain the role of business goals and objectives and ways to identify a business's goals based on publicly available information.
- Explain the profit motive in business and the reasons that businesses need to make a profit.
- Differentiate between small and large businesses, private companies, limited liability companies (LLCs), and public corporations.
- Define profit and loss and demonstrate the ability to extract information about a business's success in meeting its financial goals using profit and loss statements.
- Explain the importance of each of the main components of business management: organizational behavior, accounting, marketing, operations management, and quality management.

Introduction to the cloud

Hours: 10–15

Sample learning objectives

- Define cloud computing and describe the benefits of cloud computing versus other computational and data management platforms.
- Differentiate between physical assets and virtual resources.
- Explain the advantages and disadvantages of using cloud-based systems, archives, and platforms.
- Describe the security threats that cloud users must be aware of and the mitigation strategies that clients and managed services providers can use to improve security.
- Explain the purpose of application programming interfaces (APIs) and the way APIs are managed efficiently to drive specific business functions.
- Differentiate between applications, programming, and interface and describe how these three components work together to create a user-friendly web form.
- Differentiate between local and remote services, explaining the advantages and disadvantages of each.
- Differentiate between infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS) and provide examples of each that are commonly used by businesses in various sectors.
- Demonstrate basic knowledge of programming languages commonly used for app, website, and software and services interface solutions (C++, Python, Ansible and Node.js, Ruby, Java, and Go).
- Compare the advantages and disadvantages of AWS, Google Cloud, and Microsoft Azure.
- Differentiate between physical assets and virtual resources.
- Describe the way cloud computing services providers use regional zones.

Amazon Web Services (AWS)

Hours: 30–40

Sample learning objectives

- Explain the basic functions and capabilities of AWS cloud operations and the business uses for which AWS is most appropriate.
- Describe the infrastructure as a service (IaaS), platform as a service (PaaS), and packaged software as a service (SaaS) offerings available through AWS.
- Demonstrate the ability to evaluate pay-as-you-go pricing contracts to ensure alignment between a business's needs and the AWS services being offered.
- Develop data services maps to fit the needs of real or fictitious clients in various business sectors, such as retail, medicine, consulting, government, and nonprofit service providers.

- Describe the services provided by AWS and identify the appropriate services given a business's size, purpose, and computing needs.
- Define the essential components of configuration management, including appropriate ways to maintain records of services used, contract renewal requirements, and system limits.
- Explain the storage options available through AWS and the advantages of each.
- Develop a plan for customer migration to the cloud or to a hybrid cloud.

Google Cloud

Hours: 30–40

Sample learning objectives

- Describe the services available through Google Cloud and the use of “projects” to organize and manage those services.
- Describe the process for creating a Google project.
- Demonstrate the ability to review and interpret information on the Google Cloud console.
- Explain the process by which app APIs provide access to services and demonstrate the ability to use Python to make minor modifications to services provided through app APIs.
- Differentiate between private, partner, and public APIs and demonstrate a basic understanding of the use of admin APIs to integrate various applications needed to support business functions.
- Explain how Google Cloud can be used for advanced data analysis and database management and demonstrate the ability to set up a database using one or more Google data services.

Microsoft Azure

Hours: 30–40

Sample learning objectives

- Describe the use of Azure to develop functional websites that meet specific business needs.
- Explain how Azure functions to confirm or manage user identities.
- Demonstrate the ability to use Azure to discover user behaviors.
- Demonstrate the ability to develop, distribute, or beta test mobile apps using mobile services provided by Azure.
- Explain the storage services available through Azure and describe when and why a business might use each of those services to meet its business function.
- Describe the ways in which Azure AI provides machine learning to optimize business functions, enable easier customer use of mobile apps, and improve systems security.

Project management

Hours: 10–15

Sample learning objectives

- Describe the key elements of effective project management.
- Demonstrate the ability to define key tasks in a given project and determine how long each task will take and how task interdependencies can enhance or derail a project management plan.
- Use cloud services to develop project management timelines and task assignments.
- Demonstrate the ability to communicate to various members of the project management team and explain how decision-making hierarchies should be observed in project management decisions.

Relevant military experience

MOS 25B is the military occupation of IT specialists. FA30 is the occupational code for information operations officers, who are generally required to have at least a four-year degree. Most IT jobs in the military require individuals to have a security clearance.

Diversity, equity, and inclusion

According to *The State of DEI in Tech in 2022*, more than half of the women, Black people, and Hispanic/Latino people in the technology workforce feel they have been the victim of discrimination in the form of either reduced opportunities for advancement or wage discrimination. The report found that 70 percent of women technologists planned to change employers in the next year for better compensation. Other reports (listed below) have similar findings, which is especially troubling given persistent workforce shortages in the tech sector.

Dice, [2022 Equality in Tech Report](#) (Centennial, CO: Dice, 2022).

Sunny Betz, “DEI Efforts Help but Tech Industry Still Falls Short: Report,” Built In, March 17, 2022, <https://builtin.com/diversity-inclusion/state-of-dei-in-tech-2022-results>.

Maggie Wooll, “Diversity in Tech: Closing the Gap in the Modern Industry,” BetterUp blog, December 13, 2021, <https://www.betterup.com/blog/diversity-in-tech>.

The IT sector has made little progress in either diversifying its workforce or reducing the level of discrimination reported by Black people, Hispanic/Latino people, and women. In part, the sector’s lack of diversity is the result of a lack of diversity in computer science departments at colleges and universities and among students who enroll in computer science programs. Apprenticeship may offer significant opportunities to increase the diversity of the IT workforce by removing the considerable barriers individuals face when enrolling in college or university computer science programs.

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